Pilot-Controller Communication Errors: An Analysis of Aviation Safety Reporting System (ASRS) Reports

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13. ABSTRACT (Maximum 200 words)

The purpose of this study was to identify the factors that contribute to pilot-controller communication errors. Reports submitted to the Aviation Safety Reporting System (ASRS) offer detailed accounts of specific types of errors and a great deal of insight as to why they occur. The communication errors found in this study could be classified into three types: Readback/hearback errors (the pilot reads back the clearance incorrectly and the controller fails to correct the error), the absence of a pilot readback, and Hearback Errors Type II (the controller fails to notice his or her own error in the pilot's correct readback).

In the 386 reports analyzed, the most common contributing factors were: similar call signs on the same frequency, pilot expectations (e.g., accepting a clearance that they expected rather than what the controller actually said), and high controller workload. The identified results of these communication errors were (in order of prominence): altitude deviations, loss of standard separation, ATC operational errors, pilots landing on the wrong runway, and runway transgressions. The report concludes with recommendations for reducing the number of communication errors between pilots and controllers.

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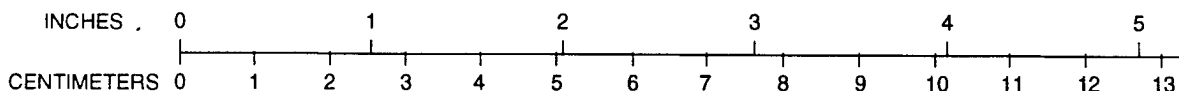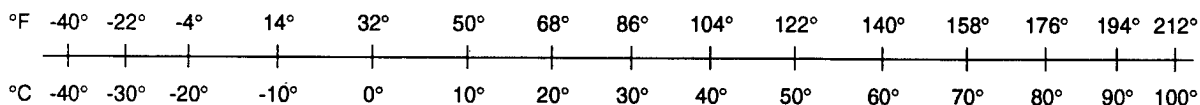| 17. SECURITY CLASSIFICATION OF REPORT Unclassified	18. SECURITY CLASSIFICATION OF THIS PAGE Unclassified	19. SECURITY CLASSIFICATION OF ABSTRACT Unclassified	20. LIMITATION OF ABSTRACT

PREFACE

METRIC/ENGLISH CONVERSION FACTORS

ENGLISH TO METRIC

LENGTH (APPROXIMATE)

1 inch (in) = 2.5 centimeters (cm)
1 foot (ft) = 30 centimeters (cm)
1 yard (yd) = 0.9 meter (m)
1 mile (mi) = 1.6 kilometers (km)

AREA (APPROXIMATE)

1 square inch (sq in, in^2) = 6.5 square centimeters (cm^2)
1 square foot (sq ft, ft^2) = 0.09 square meter (m^2)
1 square yard (sq yd, yd^2) = 0.8 square meter (m^2)
1 square mile (sq mi, mi^2) = 2.6 square kilometers (km^2)
1 acre = 0.4 hectare (ha) = 4,000 square meters (m^2)

MASS - WEIGHT (APPROXIMATE)

1 ounce (oz) = 28 grams (gm)
1 pound (lb) = .45 kilogram (kg)
1 short ton = 2,000 pounds (lb) = 0.9 tonne (t)

VOLUME (APPROXIMATE)

1 teaspoon (tsp) = 5 milliliters (ml)
1 tablespoon (tbsp) = 15 milliliters (ml)
1 fluid ounce (fl oz) = 30 milliliters (ml)
1 cup (c) = 0.24 liter (l)
1 pint (pt) = 0.47 liter (l)
1 quart (qt) = 0.96 liter (l)
1 gallon (gal) = 3.8 liters (l)
1 cubic foot (cu ft, ft^3) = 0.03 cubic meter (m^3)
1 cubic yard (cu yd, yd^3) = 0.76 cubic meter (m^3)

TEMPERATURE (EXACT)

°C=5/9(°F - 32)

METRIC TO ENGLISH

LENGTH (APPROXIMATE)

1 millimeter (mm) = 0.04 inch (in)
1 centimeter (cm) = 0.4 inch (in)
1 meter (m) = 3.3 feet (ft)
1 meter (m) = 1.1 yards (yd)
1 kilometer (km) = 0.6 mile (mi)

AREA (APPROXIMATE)

1 square centimeter (cm^2) = 0.16 square inch (sq in, in^2)
1 square meter (m^2) = 1.2 square yards (sq yd, yd^2)
1 square kilometer (km^2) = 0.4 square mile (sq mi, mi^2)
10,000 square meters (m^2) = 1 hectare (ha) = 2.5 acres

MASS - WEIGHT (APPROXIMATE)

1 gram (gm) = 0.036 ounce (oz)
1 kilogram (kg) = 2.2 pounds (lb)
1 tonne (t) = 1,000 kilograms (kg) = 1.1 short tons

VOLUME (APPROXIMATE)

1 milliliter (ml) = 0.03 fluid ounce (fl oz)
1 liter (l) = 2.1 pints (pt)
1 liter (l) = 1.06 quarts (qt)
1 liter (l) = 0.26 gallon (gal)
1 cubic meter (m^3) = 36 cubic feet (cu ft, ft^3)
1 cubic meter (m^3) = 1.3 cubic yards (cu yd, yd^3)

TEMPERATURE (EXACT)

°F=9/5(°C) + 32

QUICK INCH-CENTIMETER LENGTH CONVERSION

INCHES	0	1	2	3	4	5

CENTIMETERS	0	1	2	3	4	5	6	7	8	9	10	11	12	13

QUICK FAHRENHEIT-CELSIUS TEMPERATURE CONVERSION

°F	-40°	-22°	-4°	14°	32°	50°	68°	86°	104°	122°	140°	158°	176°	194°	212°
°C	-40°	-30°	-20°	-10°	0°	10°	20°	30°	40°	50°	60°	70°	80°	90°	100°

For more exact and or other conversion factors, see NIST Miscellaneous Publication 286, Units of Weights and Measures. Price $2.50. SD Catalog No. C13 10286.

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EXECUTIVE SUMMARY

Safe and expeditious air traffic depends upon accurate and efficient communications between pilots and controllers. This requirement for effective communication becomes even more critical as the amount and complexity of air traffic increases with attempts to increase capacity.

Studies of actual pilot and controller communications (e.g., Cardosi, 1994; Morrow, Lee, and Rodvold, 1993) reveal an astonishingly low error rate. These studies analyzed voice tapes from ATC facilities and found that less than one percent of these voice communications resulted in a communication error that affected the accuracy of the communication. This low error rate does not detract from the potential seriousness of even a single error. Also, in terms of communication errors per hour, the numbers are quite startling; across ATC environments (en route, TRACON, local control and ground control) the number of readback errors on a single frequency was close to one per hour. The first step in reducing the incidence of communication errors is to understand why they happen.

The purpose of this study was to identify the factors that contribute to communication errors. Reports submitted to the Aviation Safety Reporting System (ASRS) offer detailed accounts of specific types of errors and a great deal of insight as to why the pilots and controllers involved believe these errors occurred. Because of this, ASRS reports provide an efficient means of studying communication errors at a level of detail that is not feasible from more objective materials (i.e., voice tapes).

A total of 386 reports were included in this analysis. The communication errors found in this study could be classified into three types:

1) Readback/Hearback errors - the pilot reads back the clearance incorrectly and the controller fails to correct the error - accounted for 47% of the errors found in this analysis.

2) No pilot readback. A lack of a pilot readback contributed to 25% of the errors found in this analysis.

3) Hearback Errors Type II - the controller fails to notice his or her own error in the pilot's correct readback or fails to correct critical erroneous information in a pilot's statement of intent - accounted for 18% of the errors found in this analysis.

Many factors contributed to these errors. The most common factors were: similar call signs on the same frequency, pilot expectations (e.g., leading them to accept a clearance that they expected rather than what the controller actually said), and high controller workload. The identified results of these communication errors were (in order of prominence): altitude deviations, loss of standard separation, ATC operational errors[1], pilots landing on the wrong runway, and runway transgressions.

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[1] The term "operational error" here and throughout this report refers to a situation that, in the ASRS analyst's judgement, would have resulted in an operational error as defined by the FAA.

It is important to realize that the proportions presented in these data **in no way** represent the proportions of results of communications in the operational environment. Most communication errors are corrected on the spot and are not reported to ASRS. Usually, only the errors with potential consequences (such as a pilot deviation) would merit a report. However, the data contained in ASRS reports are useful in understanding the nature of communication errors and the factors that contribute to them, and in identifying corrective measures to reduce their incidence.

The following recommendations are offered for reducing the number of communication errors between pilots and controllers:

- **Controllers should be encouraged to speak slowly and distinctly.** In a laboratory study, the rate of pilot readback errors and requests for repeats more than doubled when the same controller gave the same complex clearances in a faster speaking voice. With a normal rate of speech (156 words per minute), 5% of the controller's instructions resulted in a readback error or a request for repeat. This rate rose to 12% when the controller spoke somewhat faster (210 words per minute) (Burki-Cohen, personal communication). (As a reference, the average newscaster speaks at about 180 words per minute.)

- **Controllers should be encouraged to keep their instructions short with no more than four instructions per transmission.** The complexity of the controller's transmission has a direct effect on the pilot's ability to remember it - there are fewer pilot errors with the less complex transmissions.

- **Pilots should respond to controller instructions with a full readback of critical components.** An altitude, heading, or airspeed should be read back *as an altitude, heading, or airspeed.* For example, "Climbing to 230, Aircraft XYZ" contains critical information that "Roger, 230 for Aircraft XYZ" does not. When more than one runway is in use, clearances to takeoff and land should be acknowledged with a readback of the clearance that includes the runway number.

- Controllers should try to treat the readbacks as they would any other piece of incoming information - use it. **Actively listen to the readback and check it against the flight strip notations** to ensure that the message that the pilot got was the one you wanted him or her to get.

- **When there are similar call signs on the frequency, controllers should continue to announce this fact;** this will alert pilots and may help to reduce the incidence of pilots accepting a clearance intended for another aircraft.

- **When there are similar call signs on the frequency, pilots should be encouraged to say their call sign before and after each readback.** This gives the controller added information as to which aircraft accepted the clearance.

- **Controllers should refrain from issuing "strings" of instructions to different aircraft.** Issuing strings of instructions to different aircraft without allowing the opportunity for each aircraft to respond directly after the controller's transmission has two undesirable effects. First,

it increases the likelihood of a miscommunication. A pilot's memory for an instruction can be hindered by extraneous information presented before or after it. Second, it decreases the likelihood of a pilot readback, as it sends the message, "I'm too busy for your readback to be important right now." A pilot's readback is the quickest mechanism for ensuring that the message was received by the intended aircraft and understood. There is another important aspect to the readback/hearback process that is often overlooked. While a controller's hearback of the pilot's readback is intended to ensure that the pilot '*got* it right', it also offers an opportunity to help ensure that the controller *gave* it right.

1. INTRODUCTION

Safe and expeditious air traffic depends upon accurate and efficient communications between pilots and controllers. This requirement for effective communication becomes even more critical as the amount and complexity of air traffic increases. In an ideal aviation world, unambiguous controller transmissions would be followed by a correct pilot readback and a flawless execution of the controller's instruction. In the real world, however, congested frequencies, faulty communications equipment, pilot and controller expectations, workload, and other human factors conspire to challenge effective communications.

Studies of pilot and controller communications (e.g., Cardosi, 1994; Morrow, Lee, and Rodvold, 1993) reveal an astonishingly low error rate. These studies analyzed voice tapes from ATC facilities and found that less than one percent of these voice communications resulted in a communication error that affected the accuracy of the communication. Such a low error rate is a tribute to the pilots and controllers in the National Airspace System. This does not detract, however, from the potential seriousness of even a single error. Also, in terms of communication errors per hour, the numbers are quite startling; across ATC environments (en route, TRACON, local control, and ground control) the number of readback errors on a single frequency was close to one per hour. The first step in reducing the incidence of communication errors is to understand why they happen.

The purpose of this study was to identify the factors that contribute to communication errors. Reports submitted to the Aviation Safety Reporting System (ASRS) offer detailed accounts of specific types of errors and a great deal of insight as to why the pilots and controllers involved believe these errors occurred. Because of this, ASRS reports provide an efficient means of studying communication errors at a level of detail that is not feasible from more objective materials (i.e., voice tapes).

ASRS reports are submitted voluntarily by pilots, controllers, and others on events they encountered that may affect air safety. ASRS reports on communication difficulties often contain very detailed information on the factors that, in the reporter's opinion, contributed to the error. These reports, filed by pilots and controllers, usually describe an error that they themselves made. While there is a provision for limited immunity for pilots who file ASRS reports, these reports are usually submitted in the hopes that the information will be used to enhance aviation safety by contributing to the study of human error and to help prevent others from making the same mistakes.

ASRS reports provide an invaluable database for studying the causes and consequences of communication errors. These reports have inherent limitations since the events described are not routinely independently verified and usually present only one side of the story. However, they do offer detailed accounts of specific types of errors and a great deal of insight as to why they believe these errors occurred. Because of this, ASRS reports provide a means of studying communication errors at a level of detail that is not feasible from more objective materials (i.e., voice tapes). However, the analysis of these reports must be interpreted in the context of the constraints of the database. While these constraints do not detract from the value of the data, they do require that care be taken in how they are interpreted. Since the reports rely on self-report, the accuracy of the data is

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subject to the accuracy of the reporters' perceptions and memory for the events. If human perceptions were 100% accurate, there would be no communication errors. Human memory is as fallible as human perception. We cannot expect ASRS reports to be as precise as analyses of ATC voice tapes. Fortunately, some of the reports do include the results of the controllers listening to the tapes; this is the only opportunity to objectively determine what occurred.

While the proportions of categories of incidents may suggest trends, they cannot be interpreted as indicative of the proportions that occur in actual operations. For example, 49% of the readback/hearback errors found in this analysis resulted in altitude deviations. This cannot be interpreted to mean that 49% of all readback errors result in altitude deviations; it only indicates that communication factors are an important underlying factor in understanding altitude deviations.

1.1 PREVIOUS ASRS RESEARCH ON PILOT-CONTROLLER COMMUNICATIONS

Communication failures between pilots and controllers is a common theme in reports submitted to ASRS. ASRS reports have been used to take a broad look at the types of communication problems that arise (Grayson and Billings, 1981) and to investigate the nature of specific problems such as readback/hearback errors (Monan, 1986), and the problem of similar call signs (Monan, 1983).

The first use of ASRS reports to examine communication errors was published in 1981. Grayson and Billings were the first to report on communication problems between the cockpit and ATC, as identified in ASRS reports. They offer a broad description of the problems of pilot expectations; similar sounding names and numbers; transposing numbers in a clearance; garbled phraseology; unsent, inaccurate, or incomplete messages; and equipment failures.

In 1983, Monan reported specifically on the "Call Sign Problem." This report identified the following factors as contributing to communication errors: poor microphone technique, dangling phraseology, use of incomplete call signs, controllers issuing strings of instructions to different aircraft, and similar sounding call signs. He cautioned pilots not to read back a "doubtful" clearance and expect the controller to correct the error.

In 1986, Monan reiterated this caution to pilots when he identified and examined the controller "hearback error", where a pilot reads back a clearance intended for another aircraft, or makes another error in the readback, and the erroneous readback goes unchallenged by the controller. Monan examined 417 instances of communication errors and described instances of inadequate acknowledgments, readback errors, and hearback errors. The analysis is descriptive and informative, but contains little data on the factors that contributed to the readback/hearback errors.

It is interesting to note that while little has changed since the "Call Sign Problem" was first reported by Monan almost 15 years ago, in terms of the nature of the problem, there has been a tremendous change in our attitude toward it. An increased awareness of the ease with which these communication errors can occur, because of similar call signs on the same frequency, and an appreciation for the potential seriousness of the consequences of these errors, has brought us a long way from the lackadaisical attitude that Monan originally reported:

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"The typical reaction of any airman or controller to the subject of ATC radio communications probably parallels the typical reaction of a housewife to the subject of the kitchen sink. Both items represent important job functions - must do activities - but the tasks involved are too commonplace, mundane, and repetitive to be intellectually challenging or capable of arousing emotional enthusiasm. Yet, the routine of controller-cockpit - controller message exchange is of the most - if not the most - important factors in navigating an aircraft safely through the airspace and the ATC structure." (Monan, 1983, p.1)

Fortunately, this complacent attitude toward communications is as outdated as the "housewife" reference. Both pilots and controllers take communications extremely seriously. The purpose of this report is to examine communication errors in detail to be able to identify procedures that will assist these dedicated professionals in further reducing the incidence of communication errors.

1.2 METHOD

A search of the ASRS database was performed for reports involving problems related to voice communications between pilots and controllers in which equipment malfunctions were not a factor. A total of 504 reports resulted from this search and were examined. All of these ASRS reports were submitted between July 1991 and May 1996, and specifically identified communication problems attributable to human factors (i.e., not relating to equipment). Many reports were excluded from analysis either because they did not specifically identify a miscommunication between pilots and controllers that was not related to equipment problems or because they lacked sufficient detail to determine the course of events. This left a total of 386 unique reports that were included in this analysis. Three hundred twenty three (76%) of these reports were submitted by pilots and 97 (23%) were submitted by controllers. (Thirty-two reports on the same incidents were submitted by both pilots and controllers, but the report was only counted once in the analysis.)

2. RESULTS

2.1 TYPES OF COMMUNICATION ERRORS

The communication errors found in this analysis can be divided into three distinct types. The first is an absence of a pilot readback. In most of these instances, the pilot merely acknowledged the clearance that he/she misunderstood. The second is the well-known readback/hearback error, where a pilot reads back a clearance incorrectly and the controller fails to catch the readback error. The third is a new classification of communication errors called *Hearback Type II* Errors. In this type of error the pilot correctly repeats the clearance that was issued, but the controller fails to notice that the clearance issued was not the intended one. This type of error also included the few instances where the pilot made a statement of action or intent that the controller should have noticed was problematic. These types of errors are mutually exclusive in that a single error can only be put into one of these categories. However, a single ASRS report can reference more than one error. For example, if a controller issued an altitude and heading, and the pilot failed to read back the heading *and* made an error in reading back the altitude clearance (and both of these turned out to be problematic in that the pilot flew the wrong heading and the wrong altitude), then this single report would contain two communication errors. There were 407 communication errors identified in the 386 reports.

As can be seen in Figure 1, readback/hearback errors were the most common type of communication errors, accounting for 47% of the errors found in this sample of reports. Errors precipitated by the absence of a pilot readback accounted for 25% of the errors and hearback type II errors accounted for 18% of the errors. All other errors, such as a pilot misunderstanding a clearance, accounted for the remaining 10% of the errors.
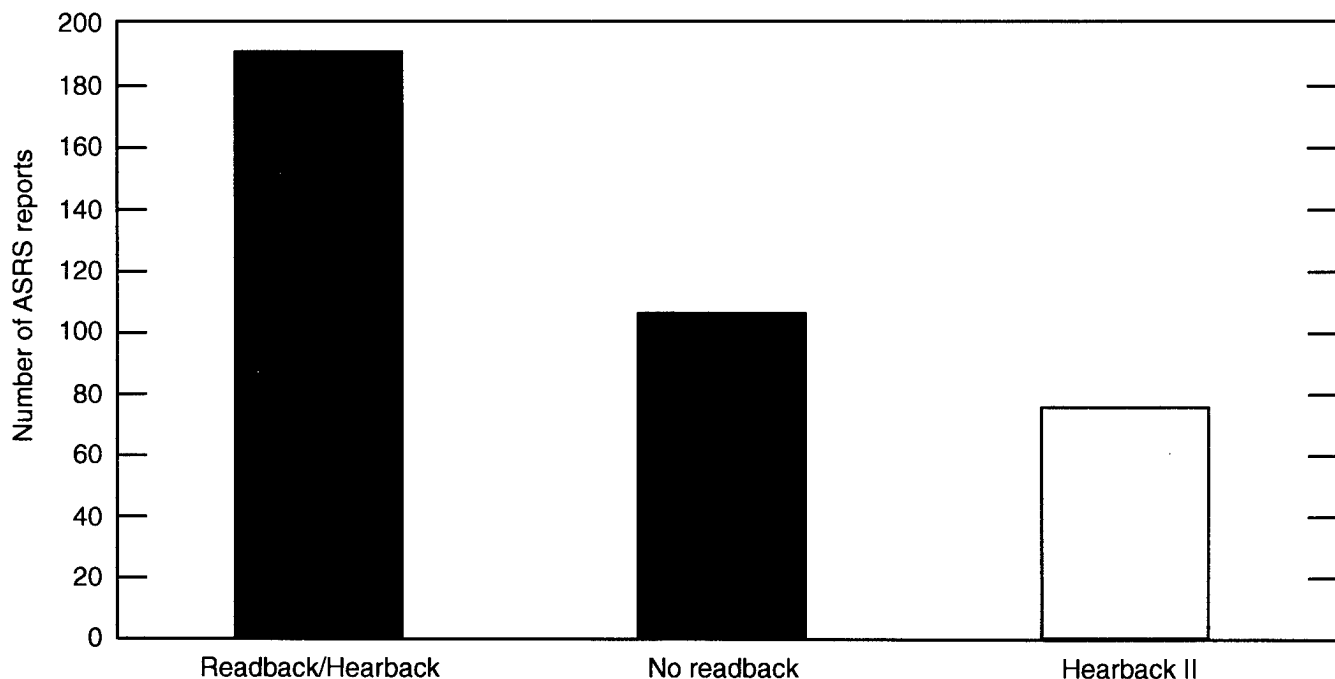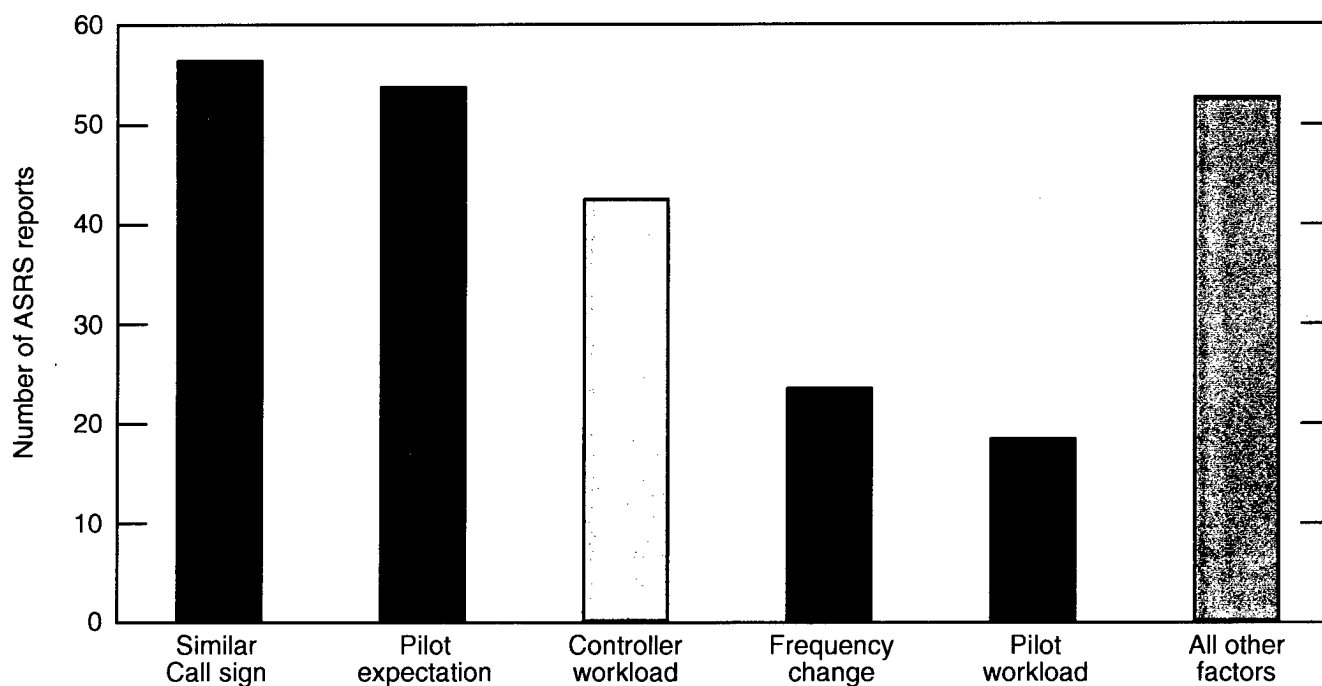

Figure 1. Types of Communication Errors

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2.2 FACTORS CONTRIBUTING TO COMMUNICATION PROBLEMS.

A frequency distribution of the factors contributing to communication errors is seen in Figure 2. There was often more than one factor cited as contributing to the error described in the report. The most commonly cited factors that contributed to communication errors were: similar call signs, pilot expectations and controller workload. The two most commonly cited contributing factors were similar call signs (on the same frequency) and pilot expectations. Similar call signs were cited in 15% of the reports and most commonly resulted in a pilot accepting a clearance intended for another aircraft. Instances of pilots hearing what they wanted or expected to hear was cited in 13% of the reports and most commonly resulted in runway transgressions; 36% of the reports citing pilot expectation as a contributing factor resulted in runway transgressions. Twenty-eight percent of the reports citing pilot expectation as a contributing factor resulted in altitude deviations. Controller workload, cited in 11% of the reports was the third most frequently cited contributing factor. Forty-five percent of the reports that cited controller workload as a contributing factor resulted in altitude deviations, 36% resulted in less than standard separation, and 29% stated that they resulted in operational errors[2]. (One report can have more than one result associated with it. For example, a report that identifies loss in standard separation, as a result, is also likely to identify an operational error as a result.)

Figure 2. Factors Perceived to Contribute to Communication Errors

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[2] The term "operational error" here and throughout this report refers to a situation that, in the ASRS analyst's judgement, would have resulted in an ATC operational error as defined by the FAA.

2.3 RESULTS OF COMMUNICATION ERRORS

The results of the reports described here are the ones specifically listed in the reports. One report can have more than one result associated with it, but only the ones specifically listed in the reports are cited. For example, a report may identify less than standard separation as a result. It cannot be assumed that this also resulted in an operational error, unless it is also specifically identified as a result. A frequency distribution of the results of the communication errors found in this analysis is seen in Figure 3. The most commonly cited results of the communication errors in this analysis were: altitude deviations, less than standard separations, operational errors, pilots accepting a clearance intended for another aircraft, and runway transgressions.
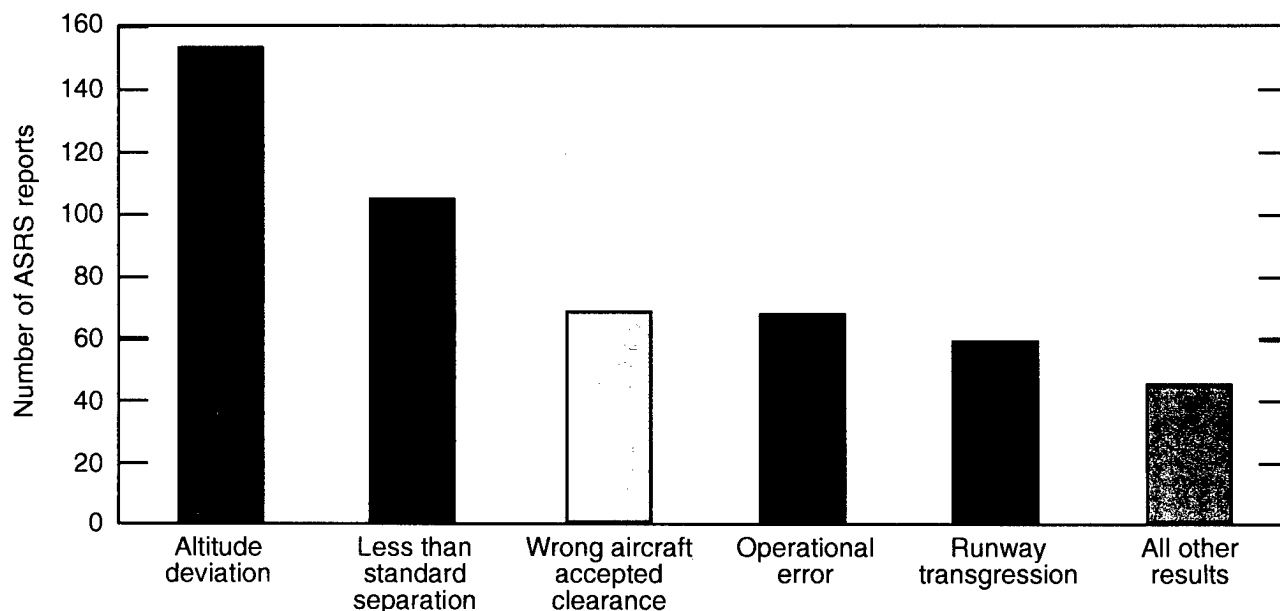
Figure 3. Results of Communication Errors

The results of this analysis can be summarized in a discussion of four types of problems in controller-pilot communications: readback/hearback errors, absence of effective readbacks, hearback type II errors, and similar call signs.

3. READBACK/HEARBACK ERRORS

A readback error is defined as an important discrepancy between the clearance that the controller issued and what the pilot read back. When the controller fails to correct this discrepancy, this is a "hearback" error. Readback errors that are corrected by controllers are not likely to result in ASRS reports since the correction of the readback usually precludes further problems. Readback/hearback errors, however, can have serious consequences; they can start a chain of events that can jeopardize safety and they contribute to operational errors. Even when the error does not result in an unsafe situation, the consequences for the controller can be serious. The following excerpt speaks to this and the perceived injustice in the consequences of these errors: "the pilot makes an error [readback error of altitude] and nothing happens. I miss one readback out of probably 100 during that rush and I get decertified and placed into a performance improvement program." (Accession Number 209860).

Studies of voice tapes from actual operations reveal that readback errors occur in less than one percent of all controller transmissions (Cardosi, Brett, and Han, 1996). Because the number of readback errors is so few in these observational studies, the factors associated with them could not be easily determined. The studies do show that, on average, 66% of these readback errors are corrected by the controller (Cardosi, Brett, and Han, 1996). The proportion of readback errors corrected by the controller varies widely with the ATC environment. While controllers corrected 89% of the readback errors en route, only 50% of the readback errors on the ground frequency were corrected. On the TRACON and local control frequencies, controllers corrected 60% and 63%, respectively. It may be that the probability of controllers catching readback errors is directly related to their momentary workload, however, a tape analysis (such as the ones from which these data were derived) is not a good vehicle to study the causes of hearback errors. First, the database is limited due to the small number of readback errors. Second, the tapes provide insufficient insight into what the controller was doing at the time of the error.

3.1 FACTORS CONTRIBUTING TO READBACK/HEARBACK ERRORS

Readback/hearback errors were the most common type of communication error found in this analysis of ASRS reports, accounting for 47% of the communication errors in the sample. Many of the reports on readback/hearback errors did not specify any contributing factors, nor could any be inferred. As Figure 4 shows, in the reports of readback/hearback errors in which a causal factor was cited, the most common contributing factor was similar call signs, followed by controller workload. Similar call signs contributed mostly to the instances in which a pilot accepted a clearance that was intended for another aircraft and the controller failed to notice that the readback had the wrong call sign associated with it.
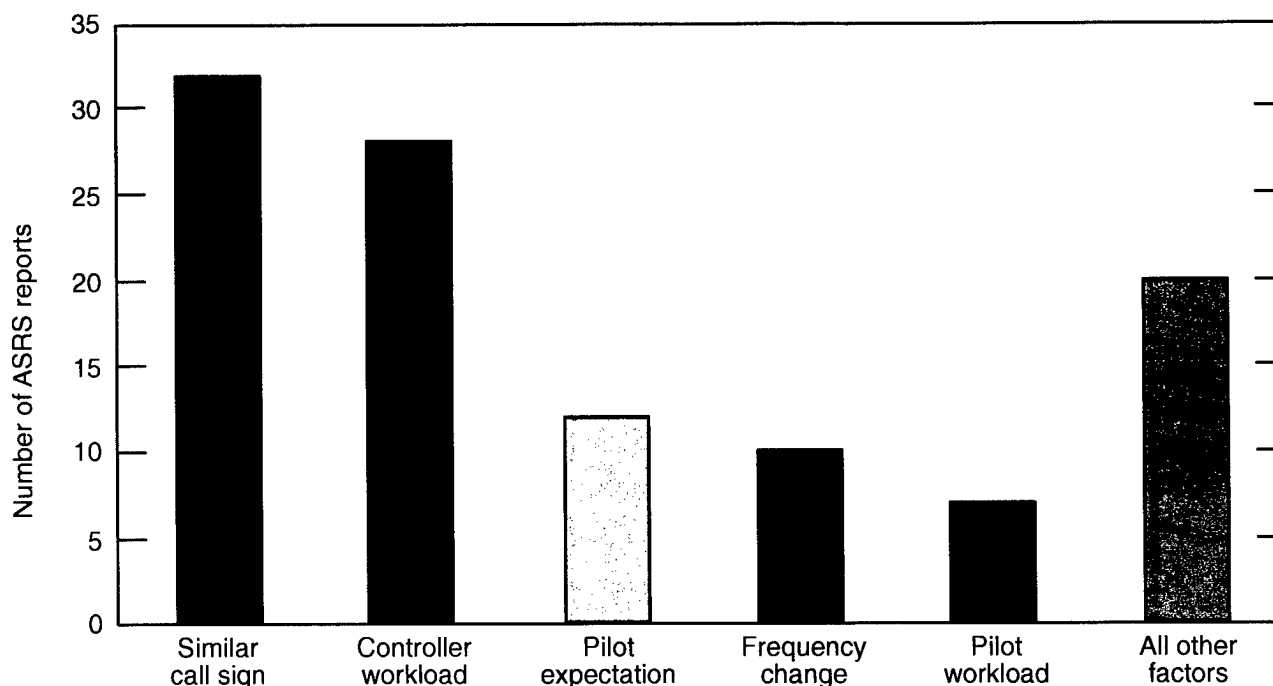
Figure 4. Factors Perceived to Contribute to Readback/Hearback Errors

The most fundamental reason behind hearback errors is perhaps too obvious to be listed as a factor in the ASRS report. We are all set up to hear what we expect to hear. Pilots notice this when they realize that the clearance they 'heard' was not the clearance that was issued. Instead, they heard what they expected to hear. Controllers suffer the same fate. Expecting to hear a correct readback (after all, this is what occurs over 99% of the time), they miss the rare discrepancy between what the pilot said and what he/she should have said. Another contributing factor to hearback errors involves the nature of the job. While the controller is listening to the readback, he/she may also be thinking about anything from their next transmission to solutions to a potential conflict. As one controller noted, "I was giving a position relief briefing to a new controller and was receiving information on a configuration change from a supervisor at the same time. This is why I missed the readback." (Accession Number 330258).

Even when a controller catches a readback error, he/she may not be completely out of the woods, as the following example illustrates:

> "Training was in progress. Traffic was heavy. Aircraft X was told, 'Climb and maintain 10,000, leaving 3,000 turn right Direct MXE, Maintain speed 250'." He read back, "OK, its 13, Direct MXE out of 2 and 250. We caught the incorrect readback on the turning altitude, but not the 13." (Accession Number 201259).

3.2 RESULTS OF READBACK/HEARBACK ERRORS

As can be seen in Figure 5, the most common result associated with readback/hearback errors was altitude deviations, followed by less than standard separation. Forty-nine percent of the reports involving readback/hearback errors listed an altitude deviation as a result. Less than standard separation was the second most commonly reported result, and was specified in 35% of the reports.

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These were followed by instances of an aircraft accepting a clearance that was intended for another aircraft (30%), ATC operational errors (23%), and heading and track deviations (10%). (*Note: These percentages do not add to 100 since more than one result can be specified in a report.)
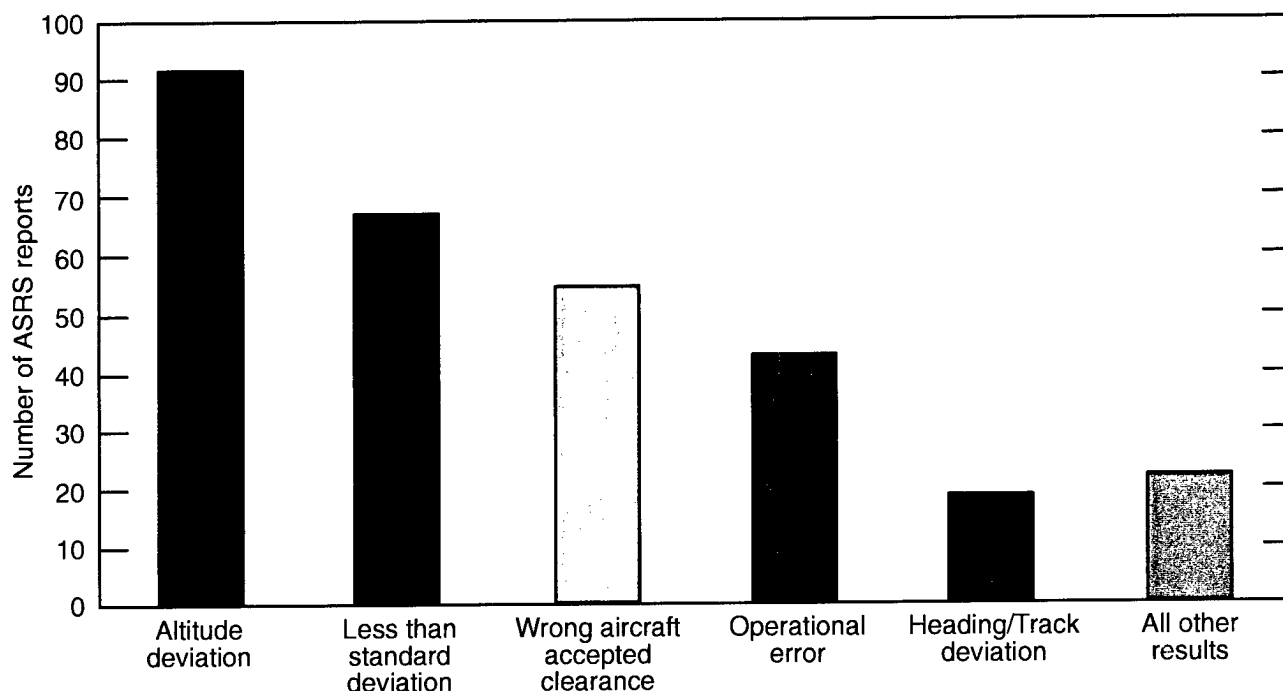
Figure 5. Results Associated with Readback/Hearback Errors

What can be done?

Hearing what we expect to hear is a natural human tendency. Experience and skill cannot compensate for this perceptual limitation. As one pilot said, "After 27 years of flying I now find it becoming easier to 'hear' things in a clearance that are not really there. More diligence is required." (Accession Number 199764).

When a clearance is different from what the pilot was told to expect, it is imperative that the controller emphasize the difference. For example, if the pilot was told to expect runway 23 *left* and is now cleared on 23 *right,* the controller should emphasize this in some way, e.g., "clear to land runway 23 right, that's 23 *right.*" If the difference is not emphasized, the pilot will be set up to hear what he/she expects rather than what is actually said.

An effective readback can mitigate the effects of expectation, as it gives the controller an opportunity to correct the error. In the following example, a readback (of what was expected, rather than what was said) saved the pilot from an unauthorized landing.

"The initial approach controller told us to expect an approach to runway 18R. This 'expect' call, plus recent flights into [airport X] with construction on Runway 18L had us all thinking runway 18R. The final controller apparently cleared us for 18L. We had the ILS

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set up for Runway 18R, were expecting 18R, and the captain read back, 'Cleared for 18R'. I headed for Runway 18R. The tower [then] cleared us to land on 18R. On landing roll, the tower advised us to contact the approach controller about a little problem with our approach. We were all wearing headsets, but heard what we expected instead of what was really coming over the headset." (Accession Number 162629).

Pilots should NEVER read back what they *thought* they *might* have heard expecting that the controller will inform the pilot of any discrepancies. **When in doubt, ASK.** As one reporter lamented, "I broke my own 'cardinal rule' by not taking questions over clearances out of the cockpit to the source." (Accession Number 300858).

It would be futile to suggest that controllers should guard against being distracted during readbacks and hearing what they expect to hear; it is the nature of the controller's job to plan one action while they are executing another. It is more practical to suggest that controllers regard the readbacks as they would any other piece of incoming information - by using it. Actively listen to the readback and check it against the flight strips notations to ensure that the message the pilot received was the correct one.

4. THE IMPORTANCE OF READBACKS

A pilot readback presents the first and most efficient opportunity to catch miscommunications. It provides a "reality check" in two ways. It tells the controller "this is what the pilot heard" to help ensure that 1) that's what the controller said, and 2) that's what the controller MEANT to say. When a clearance is acknowledged without a readback, this safety net of communications is taken away. While there are some frequencies that are occasionally too congested to accommodate full readbacks, readbacks should never be sacrificed to pilot complacency. Acknowledging a controller transmission with only a flight number gives the controller no useful information and removes any possibility that an error will be caught at the readback stage. This is illustrated in the following example:

> "Over the St. Thomas VOR the first officer requested 'direct EMI'. The controller responded with the altimeter and what I thought was, 'when able, direct EMI'. In reality, he said 'unable, direct EMI'. The first officer responded with (only) the flight number. I should have been more aware that he (first officer) did not read back 'Direct EMI'. The solution is obvious: read back all clearances." (Accession Number 163826).

In another instance, a copilot who "does not believe in complete readbacks of clearances, as that tends to clutter the frequency" (Accession Number 217581) responds "Roger" to a clearance to "position and hold" that was intended for another aircraft. This runway transgression necessitated a go-around for an incoming aircraft. Clearly, pilots should use their complete call signs to acknowledge such clearances.

4.1 FACTORS ASSOCIATED WITH NO READBACKS

The most common factor associated with a lack of a readback that resulted in a communication error was pilot expectation. In 29% of these errors, the pilot heard what they expected to hear (rather than what was actually said), gave no readback, and then did something other than what they were instructed to do. Many of these pilots were certain that they heard what they expected to hear and did not bother to confirm it with an acknowledgement. Sadly, there were also ASRS reports of one of the pilots doubting what the other pilot thought he/she heard and, yet, even in the face of this uncertainty, the transmission is STILL acknowledged without a readback. Any readback is better than a vote in the cockpit (as to what the controller said).

No other factors were strongly associated with the absence of a pilot readback. However, it is important to note that in 11% of the cases, the lack of a readback was not attributable to complacency or pilot error. In 8% of the cases, a lack of a readback was associated with frequency congestion that made it impossible to give a readback in a timely manner. In 3% of the cases, the lack of a readback was associated with the controller issuing a "string" of instructions to different aircraft with no pauses between the transmissions to allow for readbacks.

Controllers should refrain from issuing "strings" of instructions to different aircraft whenever possible. Issuing strings of instructions to different aircraft without allowing the opportunity for each aircraft to respond directly after the controller's transmission has two undesirable effects.

First, it decreases the likelihood of a pilot readback, as it sends the message, "I'm too busy for your readback to be important right now". Perhaps more importantly, it increases the likelihood of a miscommunication. A pilot's memory for an instruction can be hindered by extraneous information presented before or after it. Increasing the likelihood of the pilot not getting the message correctly, combined with a limited or nonexistent opportunity for a readback, removes the safety net that the readback provides and sets the stage for a potentially dangerous situation.

4.2 RESULTS OF NO READBACKS

The most common results of errors involving no readbacks were altitude deviations and runway transgressions. Each of these results accounted for 32% of the errors involving no pilot readback. No other results were strongly associated with this type of error.

What Can be Done?

A readback that omits critical information such as the runway number, when more than one runway is in use, is little better than no readback at all - all it tells the controller is that Aircraft X thinks they are cleared for takeoff. While this gives the controller more information than a "roger" does, it doesn't afford the protection of a complete readback. Similarly, an altitude, heading, or airspeed should be read back *as an altitude, heading, or airspeed.* For example, "Climbing to 250, Aircraft XYZ" tells the controller that the pilot heard 250 *as an altitude* whereas "Roger 250 for Aircraft XYZ" could be a readback of a heading, altitude, or speed. Similarly, when more than one runway is in use, clearances to takeoff and land should be acknowledged with a readback of the clearance that includes the runway number.

The following report illustrates the importance of including more than numbers in a readback; clearly, a little noun can go a long way toward preventing a communication error.

> "The sector was extremely busy with over 17 aircraft. I told aircraft X, "Turn left, heading 270". He said, "Roger 270". Next, I said, "Aircraft Y Turn left fly heading 270 vector for traffic." He said, "OK, leaving 310 for 270". I thought he meant that he was leaving a 310 heading for a 270 heading." (Accession Number 169149).

> This resulted in an operational error as the aircraft descended and standard separation was lost.

Pilots should respond to controller instructions with a full readback of critical components. An altitude, heading, or airspeed should be read back *as an altitude, heading, or airspeed.* When more than one runway is in use, clearances to takeoff and land should be acknowledged with a readback of the clearance that includes the runway number. Finally, readbacks should *always* contain the aircraft's call sign.

5. HEARBACK TYPE II ERRORS

Hearback Type II Errors are controller errors in which the pilot correctly repeats the clearance that was issued, but the controller fails to notice that the clearance issued was not the clearance that he/she *intended* to issue. This type of error also included the few instances in which the pilot made a statement of action or intent that the controller should have noticed was problematic.

There were 73 reports of Hearback Type II errors in this data set. Most reports involving this type of error did not specify a contributing factor. Of the reports that did offer a reason as to why these errors occurred, the most common contributing factor was controller workload. Controller workload was identified as a contributing factor in 11% of the incidents of Hearback Type II errors. As can be seen in Figure 6, the most common result of these errors was less than standard separation; 32% of the Hearback Type II errors were described as resulting in less than standard separation. Thirty percent were listed as resulting in altitude deviations and 22% specifically cited operational errors as a result. (Again, a report can specify more than one result and often the results are related such as altitude deviations and loss of standard separation.)
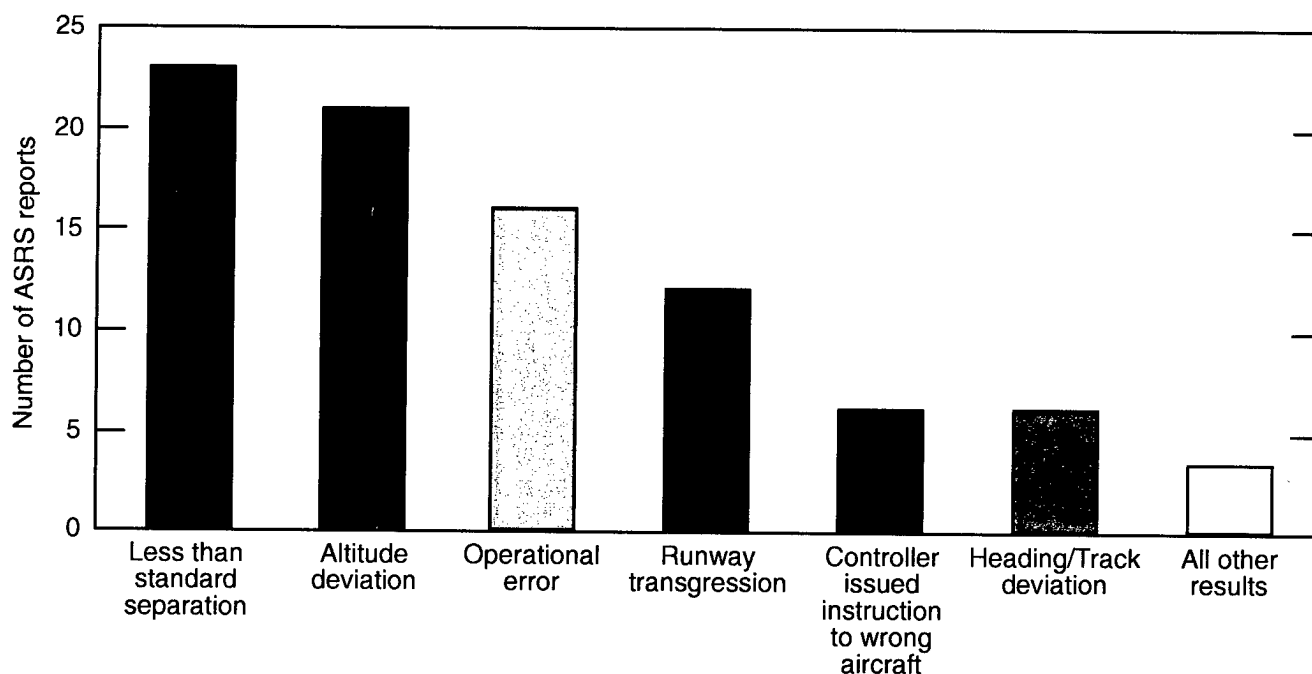
Figure 6. Results Associated with Hearback Type II Errors

The following excerpts from reports filed by controllers illustrate the nature of these errors:

> "In issuing the clearance, I gave him a wrong initial heading of 200 degrees instead of 050 degrees. The pilot read it back and I missed it on the readback." (Accession Number 199586).
> "A right turn was issued when a left turn was intended. I did not notice the readback." (Accession Number 214761).

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"I reissued the clearance to descend now to FL310, then at pilot's discretion maintain FL240, thinking all the time I had said FL280."

"Aircraft X was issued a clearance to 14000 that was meant for company Y. I even put the [wrong] altitude in the data block."

"I descended aircraft X to 4,000 feet, but meant to descend aircraft Y to 5,000. I said 4,000. [The pilot] readback 4,000. I didn't catch it....I misspoke." (Accession Number 227572).

What Can be Done?

Saying something different from what we intended to say is all too easy to do. That is why it is useful for controllers to treat the readbacks as they would any other piece of incoming information - use it. Actively listen to the readback and check it against the flight strip notations to ensure the message the pilot received was the correct one.

6. THE CALL SIGN PROBLEM

Most pilots and controllers are aware of the confusion that similar sounding call signs can cause. Call signs can sound similar because they have: the same flight number (such as AAL 123 and UAL 123), numbers that sound similar (such as "two" and "ten"), or the same numbers in different positions (such as "four thirty-two" and "three forty-two"). The problem is compounded when the flights with similar sounding numbers also have the same airline name. Similar call signs are inevitable, particularly at airline hubs, where many aircraft will have the same company name.

Similar call signs was the single most contributing factor to miscommunications between pilots and controllers. There were 56 reports involving similar call signs found in this study. Fourteen of these involved the same company name. In only one of these cases were the pilots informed by the controller that there was a similar call sign on the frequency. Again, this does not mean that controllers only inform pilots that similar call signs are on the frequency in 2% of the cases in actual operations. Rather, it points to the benefit of controllers specifically advising pilots that there is a similar call sign on the frequency.

Similar call signs on the same frequency was the major causal factor in pilots accepting a clearance intended for another aircraft. Of the 68 reports of the wrong aircraft accepting a clearance, similar call signs was cited as a contributing factor in 54% of them. In the 106 reports of a loss of standard separation, 21% stated that similar call signs were involved. More seriously, there were seven instances of reported near mid-air collisions (NMAC) in this sample; similar call signs was listed as a contributing factor in three (43%) of them.

<u>What can be done?</u>

Controllers should continue to inform pilots when there are similar call signs on the frequency. Pilots should always use their full call signs in their acknowledgements. When there are similar call signs on the frequency, stating the call sign at the beginning, and again at the end of the readback, helps to ensure that the controller knows who has accepted the clearance. Finally, controllers should NEVER assume that the pilots are aware of the similar call signs, just because there hasn't been a problem.
As one controller who filed a report of an incident that resulted in a loss of standard separation states:

> "I did not issue "similar call signs" because both pilots seemed to be aware of the other. I issued several clearances to each with no confusion." He ends his report with the following recommendation, "Solution: Don't let your guard down, even for one second." (Accession Number 169395).

Similarly, when it comes to similar call signs, we must remember that to err is human and, unfortunately, to err repeatedly is also human. The following excerpt from a report filed by a controller describes an incident that resulted in an operational error:

"I never specifically told the aircraft to be careful of similar call signs and I assumed that after catching the first mistake, they would not make the same mistake again." (Accession Number 190010).

7. ANALYSIS OF RESULTS OF COMMUNICATION ERRORS BY CONTRIBUTING FACTORS

The five most common results of the communication errors found in this study (listed sequentially from "most" to "least" common) were: altitude deviation, loss of standard separation, pilot accepting a clearance intended for another aircraft, operational error, and runway transgression. Remember that one report can identify no outcome or more than one outcome (such as altitude deviation and loss of standard separation). Similarly, a report may not identify any contributing factors or may identify more than one.

Figures 7 - 11 chart the outcomes of the communication errors by the factors that were identified as contributing to them. We can see from these figures that similar call signs on the same frequency, controller workload, and pilot expectations were the three most common factors cited in altitude deviations. Reports citing loss of standard separation identified similar call signs and controller workload as contributing factors. The factor most commonly cited as contributing to communication errors resulting in pilots accepting a clearance intended for another aircraft was similar call signs on the same frequency. Similar call signs was identified in 54% of these instances. For runway transgressions, the only clearly associated factor identified was pilot expectation (identified in 32% of the reports). The reports of operator errors most often identified similar call signs and controller workload as contributing factors.
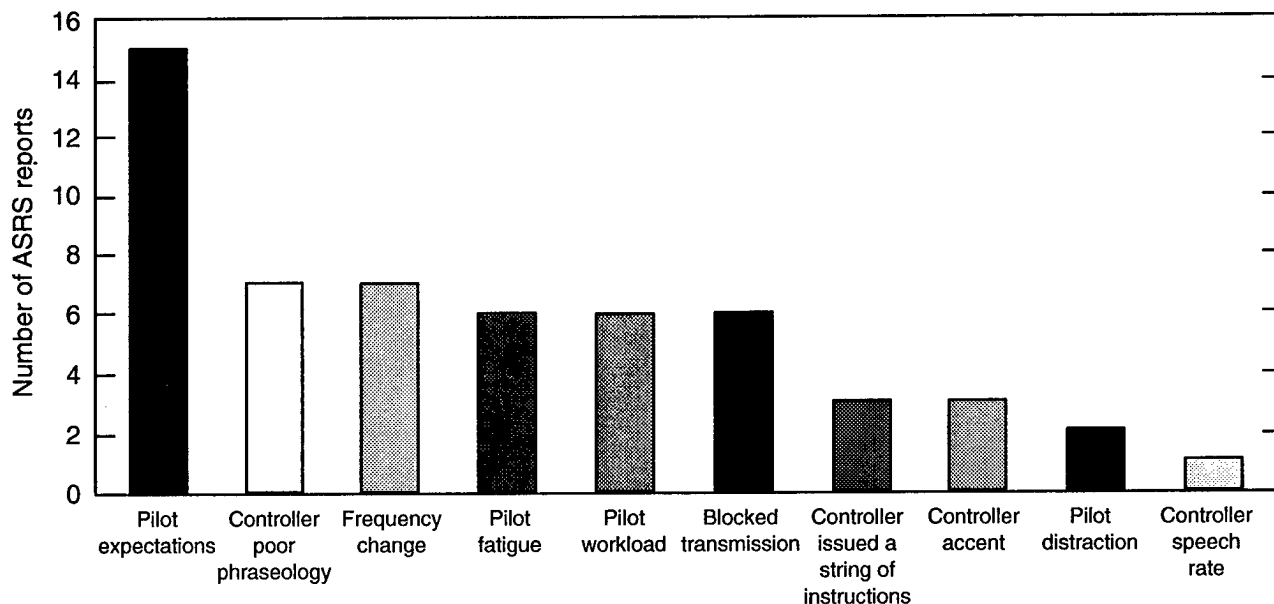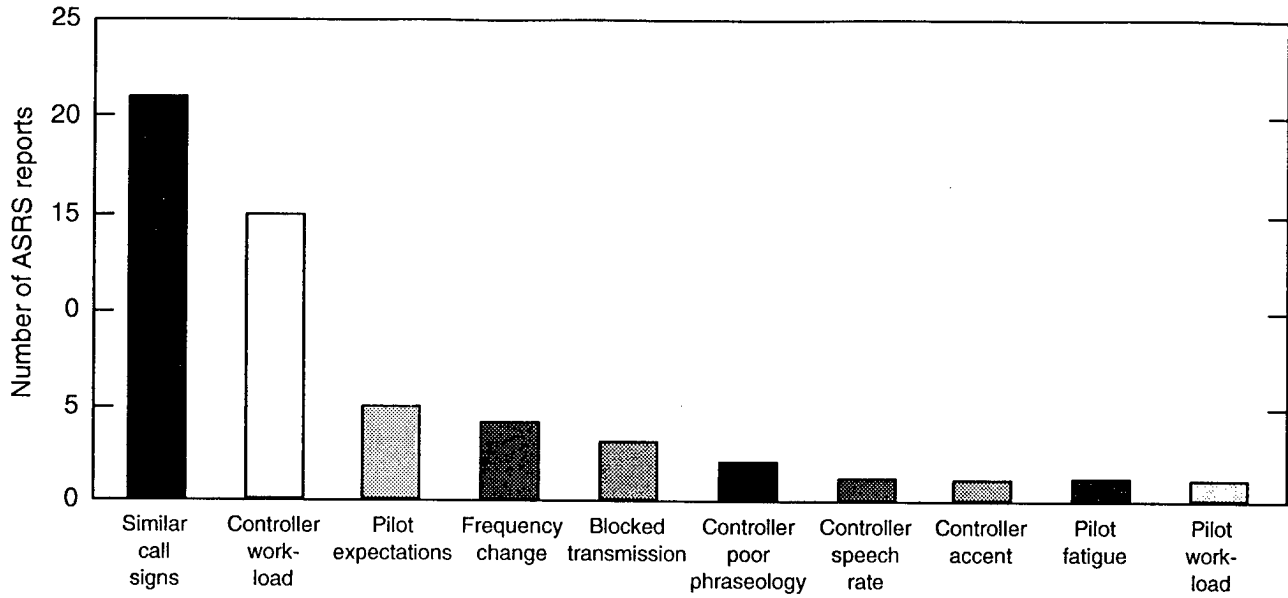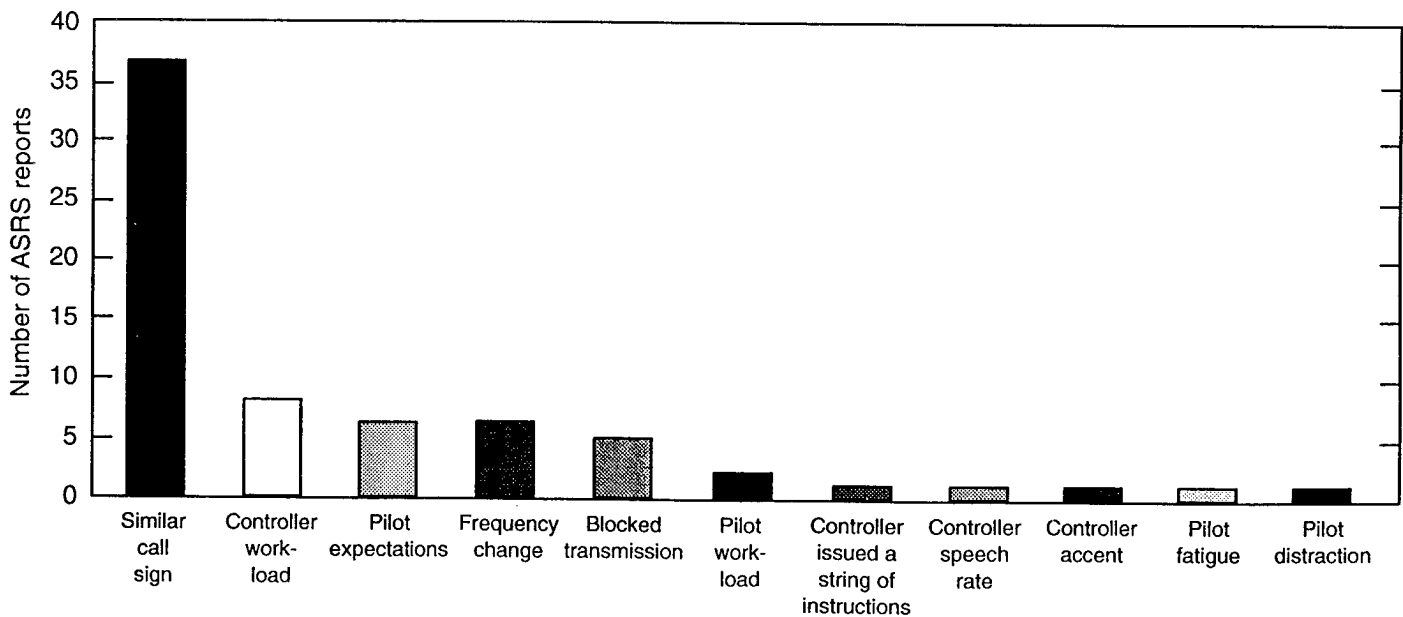

Figure 7. Altitude Deviations

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Figure 8. Loss of Standard Separation

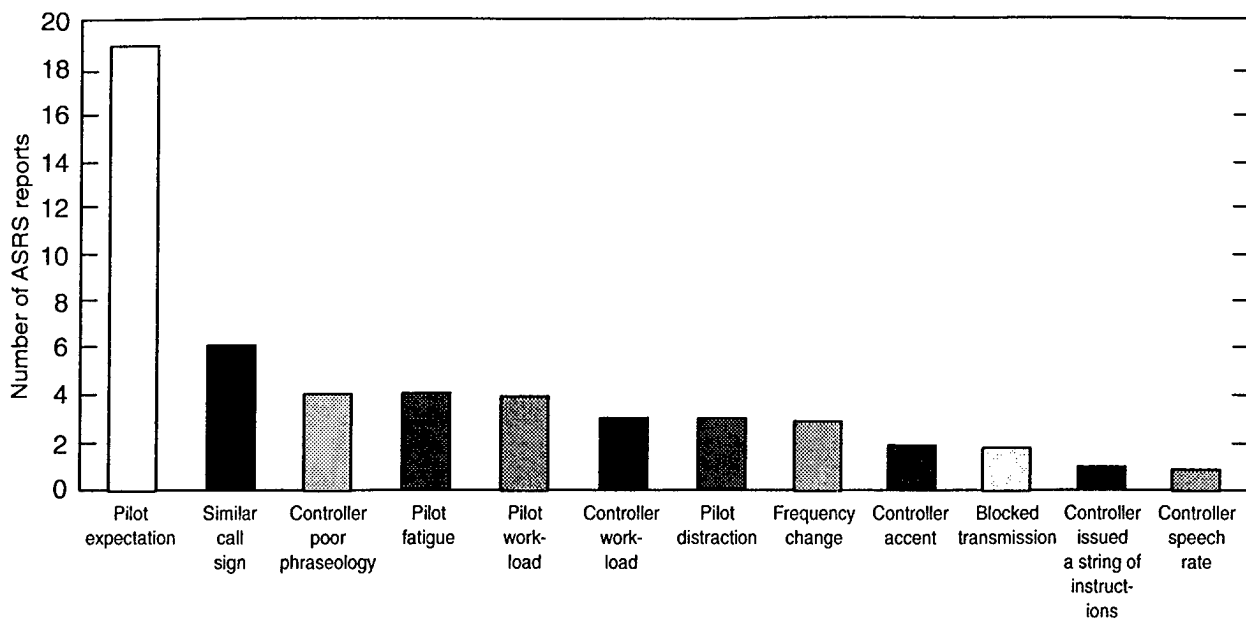**Figure 9. Aircraft Accepted a Clearance Intended for Another Aircraft**
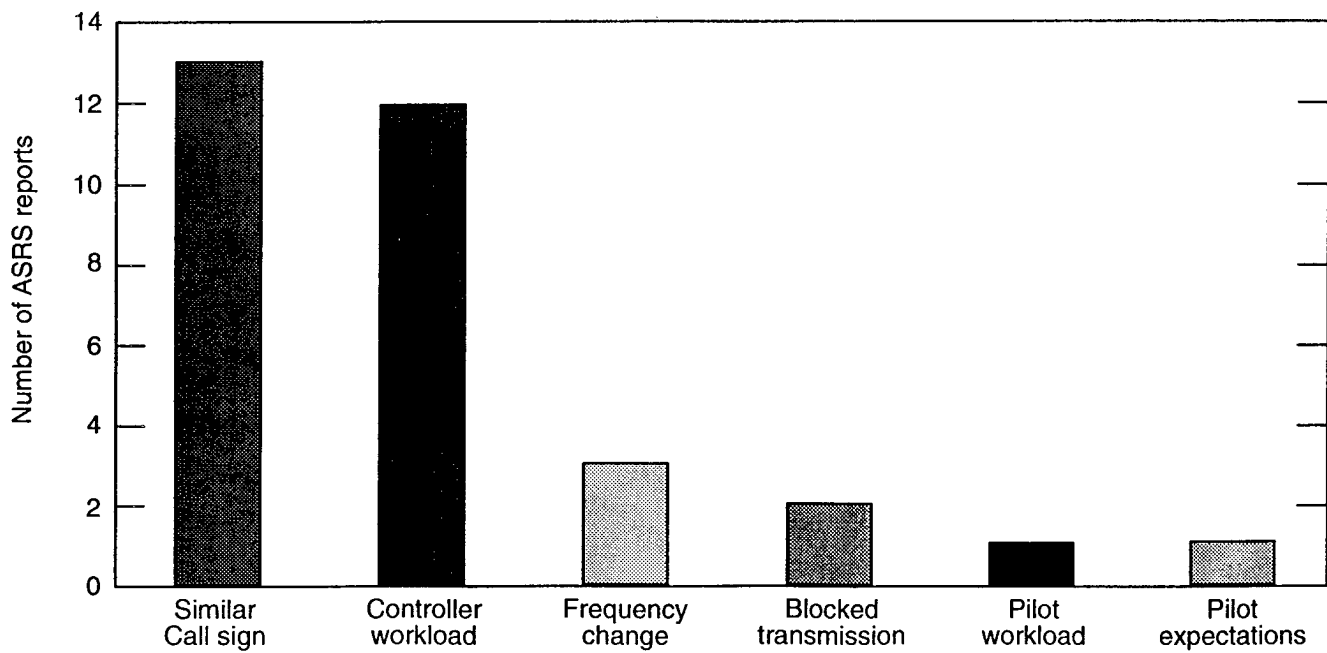
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Figure 10. Runway Transgressions

Figure 11. Operational Errors

8. COMPARISON OF THE RESULTS OF THE ANALYSES OF ASRS REPORTS WITH THE RESULTS OF TAPE ANALYSES AND OTHER STUDIES

8.1 EFFECT OF MESSAGE COMPLEXITY

In the studies of actual ATC voice tapes, the only factor that clearly affected the accuracy of the controller-pilot communication (as measured by the probability of a correct readback) was the complexity of the transmission; the less information that was contained in a single transmission, the greater the probability of a full and correct readback (Burki-Cohen, 1995; Cardosi, Brett, and Han, 1996; Cardosi, 1994; Cardosi, 1993; and Morrow and Rodvold, 1993).

The study of en route communications showed a 1-3% miscommunication rate (i.e., of readback errors and requests for repeats) for clearances containing one to four pieces of information and a 8% rate for transmissions containing five or more elements (Cardosi, 1993). Although clearances containing five or more pieces of information constituted only 4% of the messages examined, it accounted for 26% of the readback errors found in the sample. In the TRACON environment, Morrow, Lee, and Rodvold (1993) found that incorrect readbacks were more frequent for communications containing two or more pieces of information than those containing only one. In a part-task simulation study, Morrow and Rodvold (1993) found that incorrect readbacks and requests for clarification were more frequent after long messages (i.e., those containing four pieces of information) than for shorter messages. While this relation between message complexity and miscommunications was striking in the en route environment, it was not as strong in the ground control study (Burki-Cohen, 1995) and weaker, still, in the study of local tower communications (Cardosi, Brett, and Han, 1996). This is probably due to the fact that pilot familiarity with the airport is such a powerful determining factor in the pilot's ability to comprehend and recall clearances issued by tower controllers.

The effect of message complexity does not stop with communication errors. In a study of altitude deviations, pilots said that almost half (49%) of their altitude deviations involved multiple instructions being given in the same controller transmission (MiTech Inc., Carlow International Inc., and Federal Aviation Administration's Research and Development Service, 1992).

There were too few communication errors found in these tape analyses to identify contributing factors in each of these studies. Furthermore, some factors such as pilot expectation and workload are impossible to infer from tape analysis. The only contributing factor that could be identified on the tapes as being coincident with the miscommunications observed was similar call signs on the same frequency. At most, (on the TRACON frequencies) this was coincident with 6% of the miscommunications observed (Cardosi, Brett, and Han, 1996).

While the complexity of the message is a powerful determining factor in the probability of a successful transmission, it is not a factor that can be examined in the ASRS reports. First, the reports tend to focus on the part of the communication in error rather than offer a quotation of the entire transmission. Secondly, even if the report did appear to describe the entire clearance, the accuracy of the description would be questionable (since it is dependent on the accuracy of the reporter's memory for the clearance). For these reasons, message complexity cannot be identified as

a contributing factor, unless the reporter specifically mentions it in the report. Clearly, we must look to the results of the tape analysis to understand the effects of message complexity and look to ASRS reports to understand the other factors that contribute to communication errors.

8.2 TYPES OF ERRORS

The most common types of errors found in the tape analyses were readback/hearback errors and call sign discrepancies. Readback/hearback errors were also the most common type of error found in the ASRS reports on communication errors. The tape analyses found that pilots are least likely to make a readback error on altitude information, yet the most commonly reported readback/hearback error in the ASRS reports is for altitude information. In fact, 47% of the readback/hearback errors found in this study involved altitudes. This is indicative of the fact that readback errors of altitude, even though they are far less common than readbacks of other information such as radio frequencies, have much more serious (i.e., reportable) consequences than readback errors of other types of information, such as headings or frequency changes.

In the tape analyses there was a one percent incidence of pilots responding to a controller transmission with a different call sign than the controller used. Over half of these call sign discrepancies were never corrected as the controller continued to contact the aircraft with one call sign and the pilot responded to the transmission with another call sign (Cardosi, Brett, and Han, 1996). In most cases, such call sign discrepancies do not result in any ill effects, or even ambiguity, since there are other cues that controllers use to identify aircraft. In addition to the visual information that the controllers have in front of them on the flight (as to the location of the aircraft), they also have the pilot's voice. Without a call sign, the pilot's voice and the content and the context of the message are the only cues that the controller is still talking to the same aircraft. While this presents obvious opportunities for errors, it should be noted that it was a rare case when one of the instances of call sign discrepancies found in these studies resulted in a communication error. In only one case was there another aircraft on the frequency with that (erroneously used) call sign. In this case, an aircraft accepted a clearance to land that the controller intended for another aircraft. This is probably why there were so few instances of call sign errors found in the ASRS reports; it is a situation that rarely results in a serious error.

9. IMPLICATIONS OF FUTURE TECHNOLOGY

"Regardless of the level of sophistication that the air traffic system achieves by the turn of the century, the effectiveness of our system will always come down to how successfully we communicate." (Linter and Buckles, 1993)

Data link is often touted as a technology that will reduce or eliminate communication errors. Certainly, data link technology presents capabilities for reducing some forms of errors and greatly reducing frequency congestion. However, no technology can resolve all communication errors. Clearly, the pattern of errors will change. Sending clearances directly to the aircraft will eliminate the possibility of a pilot accepting a message intended for another aircraft, however, it is possible for the controller to send the message to the wrong aircraft or make another error in the message sent. For the pilot, seeing clearances in writing has several advantages over hearing them; it gives the advantage of being able to attend to it when the pilot is ready and to double check it whenever necessary. However, it is still possible to misinterpret written clearances (e.g., by transposing numbers). While no communication technology can totally prevent communication errors, careful use of data link is likely to reduce frequency congestion and reduce the likelihood of communication errors. The relative error rates observed with data link (compared to voice) will depend on the design of the equipment and the procedures used to implement it. Careful attention to human factors issues in the design and implementation of data link systems will help to realize the benefits of data link without a potentially deleterious increase in controller workload.

10. SUMMARY OF RECOMMENDATIONS

The following is a compilation of results from the results of this analysis and of analyses of voice tapes of ATC facilities.

For those pilots and controllers already using good communication practices, admonishments to "pay attention" to controller transmissions or pilots readbacks will have no effect; these professionals are already performing at their peak. However, there are many pilots and controllers whose performance could benefit from following the communication practices recommended below.

- **Controllers should be encouraged to keep their instructions short with no more than four instructions per transmission.** The complexity of the controller's transmission has a direct effect on the pilot's ability to remember it - there are fewer pilot errors with the less complex transmissions.

- **Controllers should be encouraged to speak slowly and distinctly.** In a laboratory study, the rate of pilot readback errors and requests for repeats more than doubled when the same controller gave the same complex clearances in a faster speaking voice. With a normal rate of speech (156 words per minute), 5% of the controller's instructions resulted in a readback error or a request for repeat. This rate rose to 12% when the controller spoke somewhat faster (210 words per minute). (As a reference, the average newscaster speaks at about 180 words per minute.)

- **Pilots should respond to controller instructions with a full readback of critical components.** An altitude, heading or airspeed should be readback *as an altitude, heading, or airspeed.* For example, "Climbing to 230, Aircraft XYZ" contains critical information that "Roger, 230 for Aircraft XYZ" does not. When more than one runway is in use, clearances to takeoff and land should be acknowledged with a readback of the clearance that includes the runway number and the aircraft call sign.

- Controllers should treat the readbacks as they would any other piece of incoming information - use it. **Actively listen to the readback and check it against the flight strip notations** to ensure that the message that the pilot got was the one you wanted him to get.

- **When there are similar call signs on the frequency, controllers should announce this fact;** this will alert pilots and may help to reduce the incidence of pilots accepting a clearance intended for another aircraft.

- **When there are similar call signs on the frequency, pilots should be encouraged to say their call sign before and after each readback;** this gives the controller added information as to which aircraft accepted the clearance.

- **Controllers should refrain from issuing "strings" of instructions to different aircraft.** Issuing strings of instructions to different aircraft without allowing the opportunity for each

aircraft to respond directly after the controller's transmission has two undesirable effects. First, it increases the likelihood of a miscommunication. A pilot's memory for an instruction can be hindered by extraneous information presented before or after it. Second, it decreases the likelihood of a pilot readback, as it sends the message, "I'm too busy for your readback to be important right now".

REFERENCES

Burki-Cohen, J. 1995. *An Analysis of Tower (Ground) Controller-Pilot Voice Communications.* DOT/FAA/AR-96/19.

Cardosi, K., Brett, B., and Han, S. 1996. *An Analysis of TRACON (Terminal Radar Approach Control) controller-pilot voice communications.* DOT/FAA/AR-96/66.

Cardosi, K. 1994. *An Analysis of Tower (Local) Controller-Pilot Voice Communications.* DOT/FAA/RD-93/11.

Cardosi, K. 1993. *An Analysis of En Route Controller-Pilot Voice Communications.* DOT/FAA/RD-94/15.

Grayson, R.L. and Billings, C. E., 1981. *Information Transfer between Air Traffic Control and Aircraft: Communication Problems in Flight Operations.* In Billings and Cheaney (Eds.) Information Transfer Problems in the Aviation System. NASA Technical Paper 1875, National Aeronautics and Space Administration Scientific and Technical Information Branch.

Linter, T and Buckles, J. 1993. *Why Can't We Talk to Each Other?* Journal of Air Traffic Control, January-March.

MiTech Inc., Carlow International Inc., and Federal Aviation Administration's Research and Development Service. *Altitude Deviation Study: A Descriptive Analysis of Pilot and Controller Incidents.* Final Report, October 1992.

Monan, W.P. 1986. *Human Factors in Aviation Operations: The Hearback Problem.* NASA Contractor Report 177298.

Monan, W.P. 1983. *Addressee Errors in ATC Communications: The Call Sign Problem.* NASA Contractor Report 166462. National Aeronautics and Space Administration.

Morrow, D., Lee, A., and Rodvold, M. 1993. *Analysis of Problems in Routine Controller-Pilot Communication.* International Journal of Aviation Psychology, 3(4), 285-302.

Morrow, D. and Rodvold, M. 1993. *The Influence of ATC Message Length and Timing on Pilot Communication.* NASA Contract Report 177621.

GLOSSARY

This glossary presents terms and definitions as they are used in this report. Some of these terms are presented as defined by the Aviation Safety Reporting System, and are followed by "(ASRS)."

aircraft call sign - the complete aircraft ID. For Part 121 carriers this consists of an airline name and flight number.

altitude deviation - a departure from, or failure to attain, an altitude assigned by ATC.

ASRS- Aviation Safety and Reporting System.

ATC – Air Traffic Control.

complete readback - a pilot's acknowledgement of a controller's transmission that repeats all of the key information the controller conveyed. (Note that the information does not have to be repeated verbatim, or in the same order, in this use of *complete readback*.) Also, see *partial readback*.

NMAC (Near-Midair Collision)- a conflict in which the flight crew reports (either directly, or as quoted by the controller) that the reported miss distance is less than 500 feet. (ASRS)

hearback error - the failure, on the controller's part, to notice or correct a pilot's readback error.

hearback error Type II - the failure, on the controller's part, to notice his/her own error in the pilot's correct readback. For example, if the controller instructed an aircraft to descend to 11,000, but *meant* to descend the aircraft to 10,000 and did not notice his or her own error when the pilot readback the descent to 11,000, this would be a hearback error type II.

less than standard separation - less than the legal separation between two airborne aircraft (as defined by the airspace involved). (ASRS)

operational error - less than standard separation (between two or more aircraft, or between aircraft and terrain, obstacles or obstructions, including vehicles/equipment/personnel on the runway) that occurred as a result of ATC actions, inactions, or ATC equipment malfunction. (ASRS)

readback - a pilot's acknowledgement of a controllers transmission that repeats the information that the controller conveyed.

readback error - an incorrect repeat of the controller's transmission by the pilot. For example, if the controller said, "AirCarrier 123, Descend and maintain one one thousand" and the pilot responded with "Roger, one zero thousand for AirCarrier 123", this would be a readback error since the pilot should have read back the altitude of 11,000.

reporter - a pilot or controller who files an ASRS report.

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partial readback - a pilot's acknowledgement of a controllers transmission that repeats some, but not all, of the key information that the controller conveyed. For example, if the controller issued both an altitude and heading, but only the altitude was readback, this would constitute a *partial readback*. Also see *complete readback*.

runway transgression - the erroneous or improper occupation of a runway or its immediate vicinity by an aircraft that poses a potential collision hazard to other aircraft using the runway, even if no other aircraft were actually present. (ASRS)